



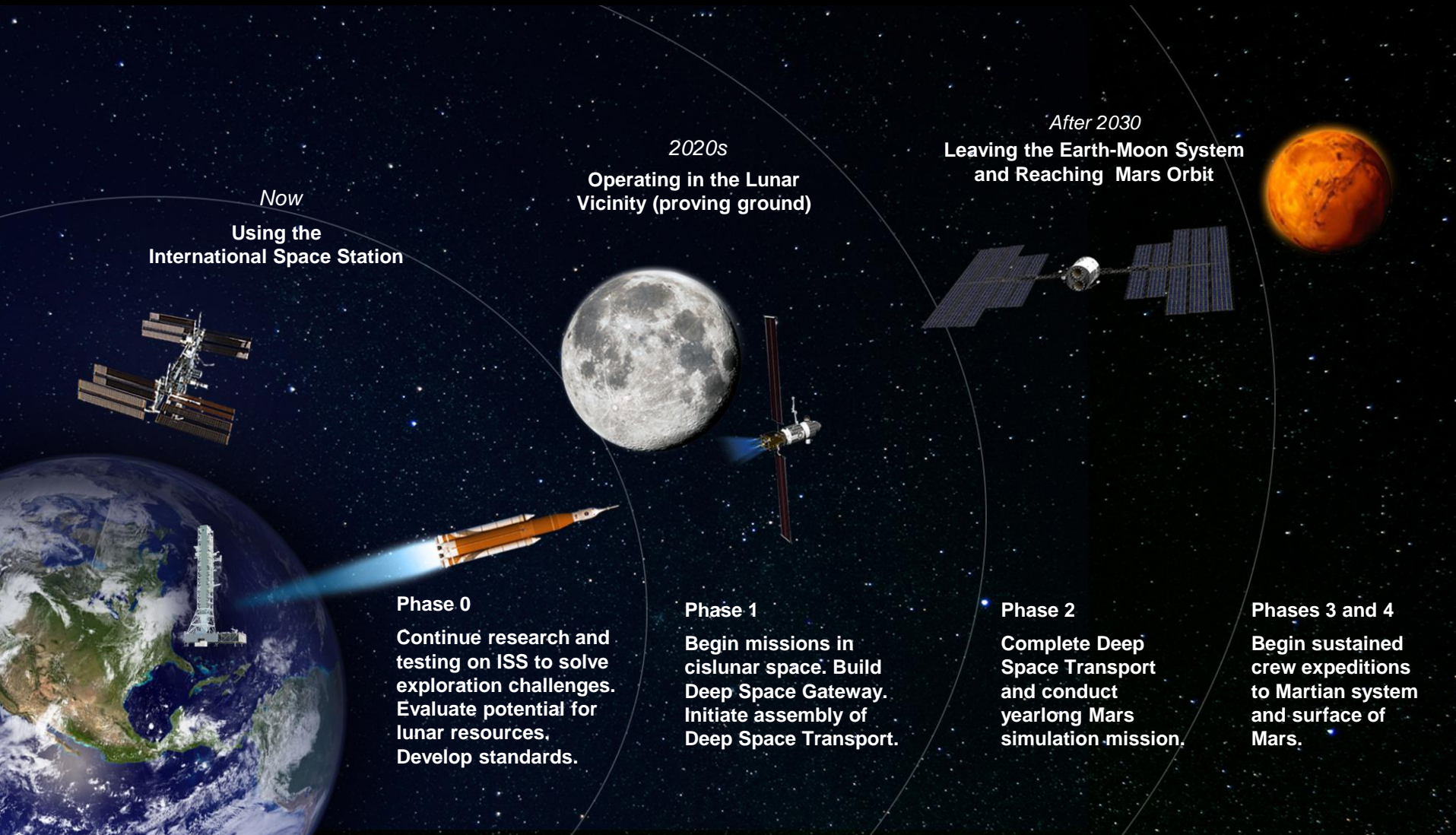
# JSC Support of NASA's Deep Space Gateway & Transport

Jose (Joe) Caram  
DSG&T SE&I Lead, JSC



# EXPANDING HUMAN PRESENCE IN PARTNERSHIP

CREATING ECONOMIC OPPORTUNITIES, ADVANCING TECHNOLOGIES, AND ENABLING DISCOVERY

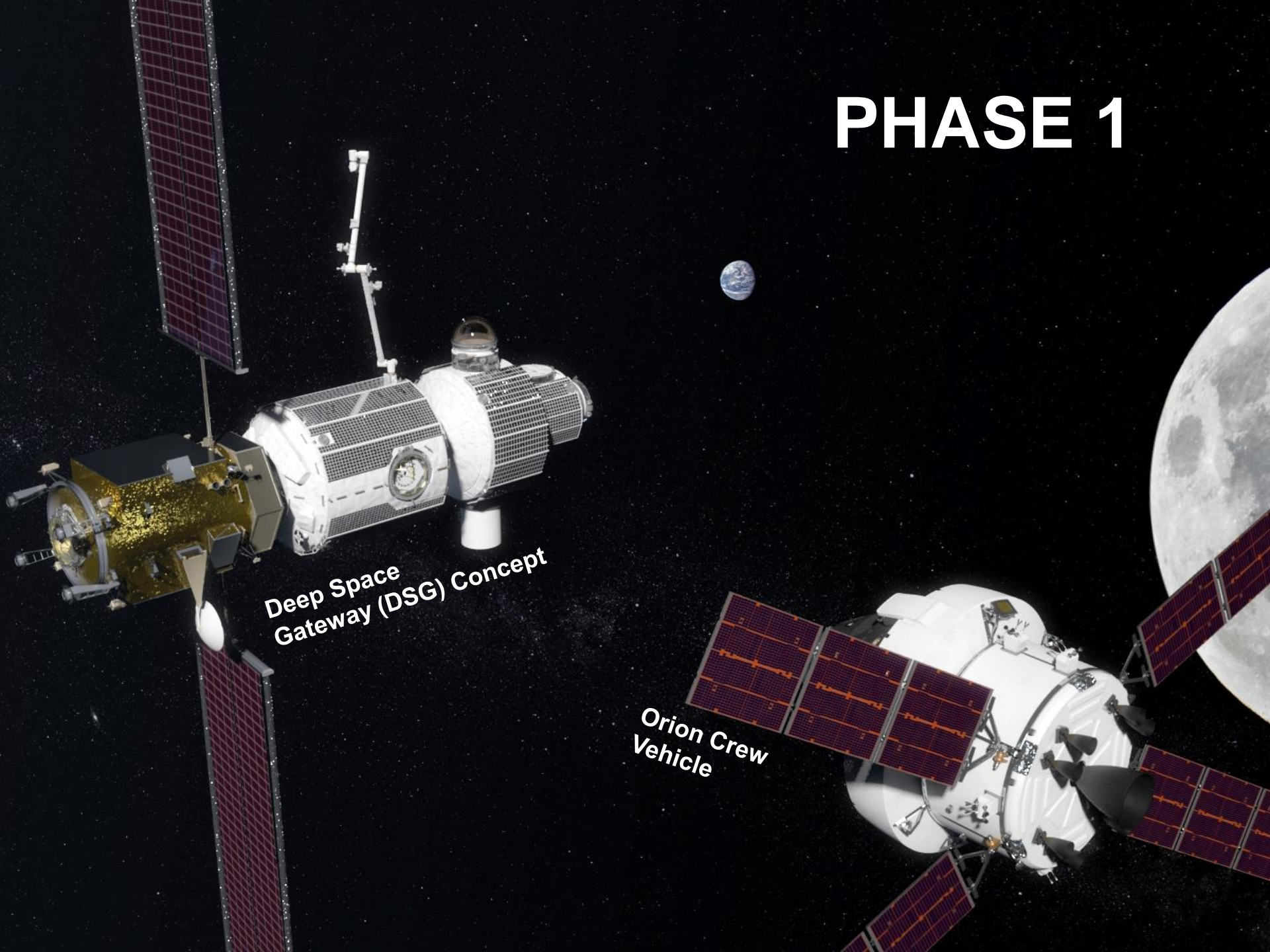




# PHASE 1

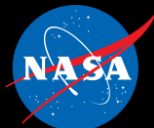
Deep Space  
Gateway (DSG) Concept

Orion Crew  
Vehicle



# Phase 1 Plan

Establishing deep-space leadership and preparing for Deep Space Transport development



		Deep Space Gateway Buildup			
EM-1	Europa Clipper	EM-2	EM-3	EM-4	EM-5
2018 - 2025					2026
SLS Block 1 Crew: 0	SLS Block 1B Cargo  Europa Clipper (subject to approval)	SLS Block 1B Crew: 4 CMP Capability: 8-9T  40kW Power/Prop Bus	SLS Block 1B Crew: 4 CMP Capability: 10mT  Habitation	SLS Block 1B Crew: 4 CMP Capability: 10mT  Logistics	SLS Block 1B Crew: 4 CPL Capability: 10mT  Airlock
Distant Retrograde Orbit (DRO) 26-40 days	Jupiter Direct	Multi-TLI Lunar Free Return 8-21 days	Near Rectilinear Halo Orbit (NRHO) 16-26 days	NRHO, w/ ability to translate to/from other cislunar orbits 26-42 days	NRHO, w/ ability to translate to/from other cislunar orbits 26-42 days
Gateway (blue) Configuration (Orion in grey)			Cislunar Support Flight	Cislunar Support Flight	

These essential Gateway elements can support multiple U.S. and international partner objectives in Phase 1 and beyond

**Known Parameters:**

- Gateway to architecture supports Phase 2 and beyond activities
- International and U.S. commercial development of elements and systems
- Gateway will translate uncrewed between cislunar orbits
- Ability to support science objectives in cislunar space

**Open Opportunities:**

- Order of logistics flights and logistics providers
- Use of logistics modules for available volume
- Ability to support lunar surface missions

# Human Exploration and Operations

## *Deep Space Gateway Functionality*



### **Assumptions**

- Deep Space Gateway provides ability to support multiple NASA, U.S. commercial, and international partner objectives in Phase 1 and beyond
- The Gateway is designed for deep space environments
  - Supports (with Orion docked) crew of 4 for a minimum of 30 days
  - Supports buildup of the Deep Space Transport

### **Emphasis on defining early Phase 1 elements**

- Gateway Power Propulsion Element
- Gateway Habitat
- Logistics Strategy

### **Future work to refine later elements; early feasibility trades complete**

- Airlock
- Deep Space Transport





Deep Space  
Gateway (DSG) Concept

A compact satellite or probe with a cylindrical body, a conical nose, and four rectangular solar panels extending from its sides. It is positioned in the upper left quadrant of the image.



Deep Space  
Transport (DST) Concept

A large, complex spacecraft structure featuring a central cylindrical module with two large circular openings at its front. It is connected to a tall, lattice-like tower that supports a large rectangular solar panel array. The entire structure is oriented vertically in the center of the image.

**PHASE 2**

# (PLANNING REFERENCE) Phase 2 and Phase 3

## Looking ahead to the shakedown cruise and the first crewed missions to Mars

Transport Delivery		Transport Shakedown		Mars Transit	
EM-6	EM-7	EM-8	EM-9	EM-10	EM-11
2027		2028 / 2029		2030+	
<p>SLS Block 1B Cargo P/L Capability: 41t TLI</p> <p>Deep Space Transport</p>	<p>SLS Block 1B Crew: 4 CMP Capability: 10t</p> <p>Logistics</p>	<p>SLS Block 1B Cargo P/L Capability: 41t TLI</p> <p>DST Logistics &amp; Refueling</p>	<p>SLS Block 2 Crew: 4 CMP Capability: 13+t</p> <p>Logistics</p>	<p>SLS Block 2 Cargo P/L Capability: 45t TLI</p> <p>DST Logistics &amp; Refueling</p>	<p>SLS Block 2 Crew: 4 CMP Capability: 13+t</p> <p>Logistics</p>
<p>DST checkout in NRHO 191-221 days</p> <p>Cislunar Support Flight</p>		<p>DSG: continued operations in cislunar space</p> <p>DST: shakedown in cislunar space with return to DSG in NRHO 300-400 days</p> <p>Cislunar Support Flight</p>		<p>DSG: continued operations in cislunar space</p> <p>DST: Mars transit and return to DSG in NRHO</p> <p>Cislunar Support Flight</p>	

Reusable Deep Space Transport supports repeated crewed missions to the Mars vicinity

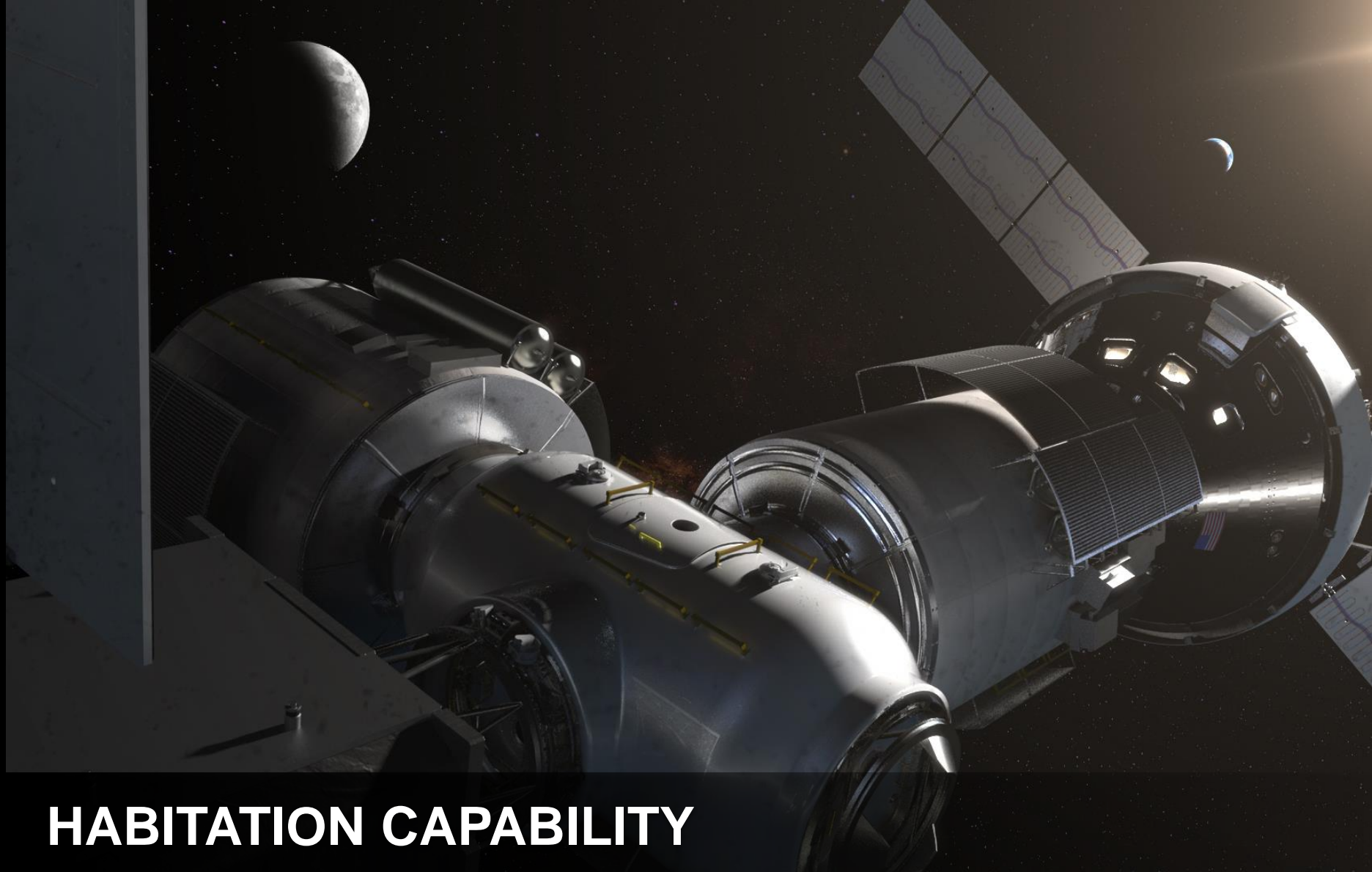
### Known Parameters:

- DST launch on one SLS cargo flight
- DST shakedown cruise by 2029
- DST supported by a mix of logistics flights for both shakedown and transit
- Ability to support science objectives in cislunar space

### Open Opportunities:

- Order of logistics flights and logistics providers
- Shakedown cruise vehicle configuration and destination/s
- Ability to support lunar surface missions





## HABITATION CAPABILITY

Systems to enable the crews to live and work safely in deep space. Capabilities and systems for use in conjunction with Orion and SLS on exploration missions in cislunar space and beyond.



# NextSTEP Habitation Overview - Commercial



## NextSTEP Phase 1: 2015-2016

Cislunar habitation concepts that leverage commercialization plans for LEO



LOCKHEED MARTIN



BIGELOW AEROSPACE



ORBITAL ATK



BOEING

**FOUR  
SIGNIFICANTLY  
DIFFERENT  
CONCEPTS  
RECEIVED**

Partners develop required deliverables, including concept descriptions with concept of operations, NextSTEP Phase 2 proposals, and statements of work.

## NextSTEP Phase 2: 2016-2018

Initial discussions  
with international  
partners



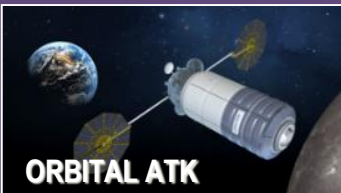
BIGELOW  
AEROSPACE

**FIVE GROUND  
PROTOTYPES  
BY 2018**

- Partners refine concepts and develop ground prototypes.
- NASA leads standards and common interfaces development.



SIERRA NEVADA  
CORPORATION



ORBITAL ATK



LOCKHEED  
MARTIN



BOEING

### ONE CONCEPT STUDY



NANORACKST IXION



Define reference habitat  
architecture in preparation  
for Phase 3.

### Phase 3: 2018+

- Partnership and Acquisition approach, leveraging domestic and international capabilities
- Development of deep space habitation capabilities
- Deliverables: flight unit(s)

# JSC Roles



- **ISS Program chairs IECST and ISCWG with responsibilities for defining IP approach for exploration**
  - ❖ IP's are proposing Hab concepts as well as other elements
- **SE&I Lead for DSG**
- **Mars Study Capability Lead – Transport**
- **Integrated Ground Test Lead for NextStep BAA**
- **Other key areas supported by JSC:**
  - Concept and Design Studies, Analysis and Product development
    - Requirements, ConOps, Standards, etc.
  - NextStep Hab BAA technical oversight
  - Mock up and Virtual Reality development

